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PLANT PROTECTION BULLETIN

A PUBLICATION OF THE WORLD REPORTING SERVICE ON PLANT DISEASES AND PESTS

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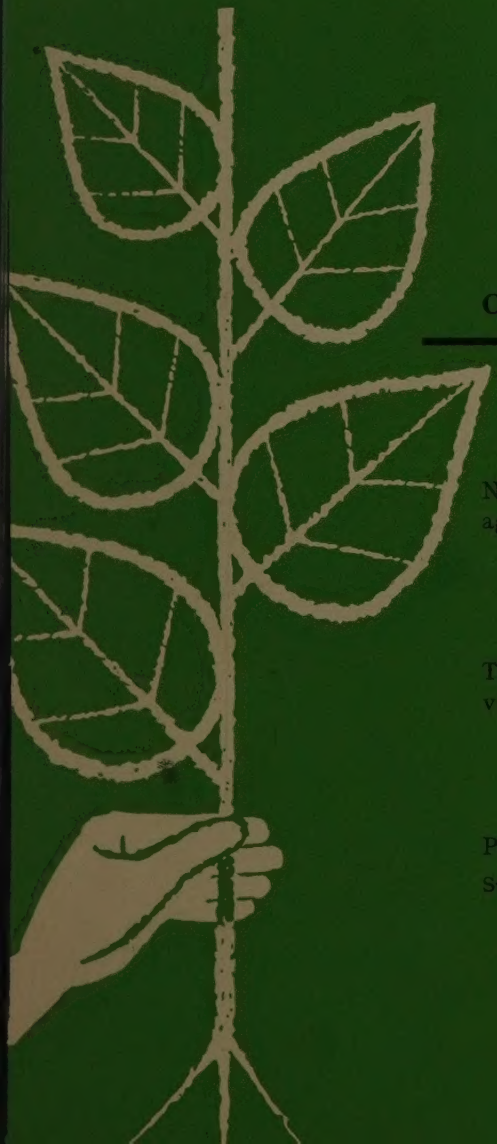

CONTENTS

is issued as a medium for the dissemination of information received by the World Reporting Service on Plant Diseases and Pests, established in accordance with the provisions of the International Plant Protection Convention, 1951. It publishes reports on the occurrence, outbreak and control of pests and diseases of plants and plant products of economic significance and related topics, with special reference to current information. No responsibility is assumed by FAO for opinions and viewpoints expressed in the Bulletin

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FAO PLANT PROTECTION BULLETIN

A PUBLICATION OF THE WORLD REPORTING SERVICE ON PLANT DISEASES AND PESTS

Notes on the biological control of pests of agriculture in Chile[1]

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This paper summarizes the work on biological control of plant pests conducted in Chile during the last 50 years, mainly by different units of the Ministry of Agriculture.

Various circumstances have been responsible for the outstanding progress made in Chile in biological control, and there is no doubt that Chile was the first South American country to systematically utilize this method with economic results. One of the principal reasons for the successful results obtained has been the similarity of agricultural and other conditions existing between Chile and California. Actually, the characteristics of climate and of crops grown in Chile and California are quite similar. In California and in Chile grapes, citrus fruit, peaches and numerous winter and spring annual crops which are identical are grown. It is not strange, then, to find that the pests which infest all of these fruits and plants are practically the same in Chile as in California. For this reason, when at the end of the last century California started using biological control in a scientific and systematically organized manner and through it very quickly obtained spectacular results, it is not surprising that Chile, with similar pests and very much the same general conditions, imported from that state the living agents of control which were being used there with such success.

As early as in 1902, through the intermediary of Teodoro Schneider (6), Chile imported in large numbers two coccinellid predators of scale insects and aphids. These predators, *Hippodamia convergens* Guer. and *Rhizobius ventralis* Er., seem to have disappeared completely, as they have never since been mentioned as existing in collections or as having been captured in the field.

Another of the first attempts to establish such useful insects in Chile was that of Carlos Camacho (7), in 1915 and 1916, to colonize in the country two chalcid parasites, *Cheiropachys colon* L. and *Raphitelus maculatus*, which at that time were being used in the United States against the shot-hole borer, *Scolytus rugulosus* Ratz., on peaches. These parasites have also disappeared even though Flaminio Ruiz, in some interesting unpublished observations, reported that ants and other common predators often extracted from tree trunks larvae of the shot-hole borer which were apparently parasitized by these chalcids.

The foregoing is a brief summary of the first Chilean experiences in biological control in which the failures are not surprising since, in those early years, the work was conducted without proper methods and without appropriate installations being available to carry out organized programs. The following enu-

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[1] Publication authorized by the Director-General of Agrarian and Fishery Production of the Ministry of Agriculture, Santiago, Chile.

[2] The author is grateful to Mr. Raúl Cortés and Mr. Gabriel Olalquiaga for their review of the manuscript of this paper and for their contribution of interesting data from their own experiences.

Melolonthinae), have for many years (9, 10) constituted a very serious economic problem in the Province of Cautín, which is the principal wheat-growing area of Chile. These grubs, as is the case in all parts of the world in which they are of economic importance, attack roots of wild and cultivated grasses during the winter and spring months. In Chile they have many natural enemies, among them various species of Thynnidae (Hymenoptera), some Tachinidae (Diptera), numerous predatory larvae (Carabidae), birds, mammals, one fungus species (*Metarrhizium anisopliae* Metch.), a nematode (*Neoaplectana* sp.), etc. Although the white grubs are subject to good natural control through the joint attack by such enemies of the larvae, occasional isolated outbreaks do occur which cause, as in 1946, extensive damage and loss to the wheat growers at Cautín.

For the control of white grubs, in 1944 the Ministry of Agriculture imported from the United States the two disease-producing bacteria, *Bacillus popilliae* Dutky and *Bacillus lentimorbus* Dutky, which in that country had given excellent control of the larvae of the Japanese beetle, *Popillia japonica* Newm. After several years of experimental work in the laboratory these bacteria, which are parasitic organisms of a melolonthine, were cultured on a new ruteline host. Laboratory experiments succeeded without difficulty in having the pathogens produce the typical disease called "bacteriosis" or "milky disease," similar to that which had been observed in the natural host in North America. However, in the field work carried out in the last ten years, numerous adverse natural factors have been encountered, such as the temperature of the soil in winter, which have prevented the pathogenic organisms from thriving and from producing the favorable results anticipated.

When the author was in the United States in 1957, he studied bacteriosis under the direction of Dr. S.R. Dutky in the laboratories of the United States Department of Agriculture at Beltsville, Maryland, and the New York State Agricultural Experiment Station at Geneva, New York. It is hoped that with the additional knowledge acquired and with Dr. Dutky's counsel, progress will now be made in the control of white grubs through the medium of this disease, as there is no more favorable solution economically than the use of the bacteria for elimination of the pests.

9. Entomological control of St. Johns-wort[3]

In 1952, the Ministry of Agriculture (8) imported from California, through the courtesy of Drs. J.K. Holloway and C.B. Huffaker and with the co-operation of the Institute of Interamerican Affairs in Chile, two European chrysomelids, *Chrysolina hyperici* Forst. and *C. quadrigemina* (Suffrain), for the purpose of initiating entomological control of the weed known as St. Johns-wort, *Hypericum perforatum* L. This weed has been found in Chile for many years and is distributed in this country from Talca to Llanquihue, causing both direct and indirect losses of considerable magnitude.

The above-mentioned chrysomelids were originally released in the field in various infested areas of the Provinces of Bio-Bio and Malleco. After seven years of activity, it is possible to state conclusively that the insects have become established in Chile where, apparently, they have not encountered adverse conditions which could limit their action. They have multiplied normally, become naturally dispersed over much larger areas than those in which they were released, and in many regions they have completely eliminated the weed.

10. Importation of parasitic nematodes

When Dr. S.R. Dutky visited Chile, in 1956, he recommended the importation of Nematode DD-136, which had recently been discovered in the United States, where it had been successfully used in the control of various species of destructive larvae. Since that time, this nematode has been studied experimentally in the National Entomological Station at La Cruz, where it has been able to survive without dif-

[3] For further information on biological control of St. Johns-wort in Chile, see López Villanueva, H. and Olalquiaga Fauré, G. 1959. Biological control of St. Johns-wort in Chile. *FAO Plant Prot. Bull.* 7: 144-146.

ficulty and to kill the larvae of 16 different species of harmful insects. It is very easily dispersed in orchards, on farms and in storages, in single-water suspensions. It has not as yet been distributed to farmers for general use.

11. Parasites of the San José scale

The San José scale, *Aspidiotus perniciosus* Comst., has occurred in Chile since approximately 1929, the year in which it was found in the vicinity of the City of Santiago. Since then it has become widespread throughout the country, attacking its usual hosts and acquiring particular importance with regard to apples, peaches, nectarines, pears, apricots, etc., which Chile exports to Europe and various South American countries.

During recent years the National Entomological Station at La Cruz has tried to import into Chile some parasites of this scale which have already been tested in the United States and in countries of the British Commonwealth. Through the kindness of Dr. David C. Lloyd, of the Fontana (California) Laboratory of the Institute of Biological Control of the British Commonwealth, the Ministry of Agriculture was able to receive several air shipments of a parasite, *Prospaltella perniciosi* Tower, during the first half of 1959. The original colonies have been maintained in good breeding condition in the laboratories of the National Entomological Station at La Cruz but they have not yet been distributed to farmers.

12. Co-operating personnel and institutions

As stated by Clausen (2) in 1946, in few other cases does international co-operation occur in as nearly perfect form as it does in biological control. In fact, the implementation of a program of biological control requires, in its initial phase, one unit which provides the agent of control, and another which receives it for distribution in a new geographic area.

In Chile, the receiving institution has almost always been the Ministry of Agriculture through its technical services, principally the Departments of Agricultural Defense (previously Plant Protection) and Agrarian Production (previously Agricultural Research). The institutions which have supplied the control agents to Chile have been, principally, the following: the University of California, through its Citrus Experiment Station at Riverside; the United States Department of Agriculture, Washington, D.C., through its numerous agencies distributed over the United States but chiefly through its laboratory at Beltsville, Maryland; and the Institute of Biological Control of the British Commonwealth through its laboratory at Fontana, California.

Many persons abroad have co-operated with Chilean personnel in carrying out the programs of biological control, among them C.P. Clausen, S.E. Flanders, S.R. Dutky, C.B. Huffaker, J.K. Holloway, D.C. Lloyd and H. Compere.

Since 1937, execution of biological control programs in Chile has been centralized in the former insectary at La Cruz, now known as the National Entomological Station of the Ministry of Agriculture, as this unit possesses the necessary personnel, laboratories, library, greenhouses, etc., for this type of work.

Credit is also due to those persons in Chile who have participated in the initiation and implementation of the biological control programs. Among them are Carlos Camacho in the period prior to 1920, and Alberto Graf, César Capdeville, Manuel Casanueva, Raúl Cortés, Gabriel Olalquiaga, Sergio Rojas and Victor Sandoval, as being among the chief persons who have been active in this work. From 1931 until 1939, Alberto Graf was the most enthusiastic promoter of biological control in Chile.

Finally, it should be pointed out that no mention has been made of the programs of biological control carried out through the use of Chilean insects within the country or of the insects which Chile has sent to other countries.

Summary

Chile can rightfully claim to be the first country in South America to have developed the field of biological control of insect pests of agriculture, having started this work as far

back as 1902, with the introduction of two valuable coccinellid predators from California.

The present article describes the main projects, whether successful or not, which have involved the introduction of beneficial organisms in attempts to control injurious species of either animals or plants.

The most successful work has been accomplished in the control of the woolly apple aphid, the cottony-cushion scale, various species of mealybugs, the black scale of olives in coastal areas, and the weed known as St. Johns-wort.

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The identification of barley stripe mosaic virus in Israel[1]

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In the spring of 1957, barley plants of different varieties were found to display symptoms similar to those characterizing barley stripe mosaic virus in a few fields in various regions in Israel. These consisted of chlorotic to whitish mottled stripes which sometimes became necrotic. Mottle intensity seemed to differ somewhat according to variety. In a seed treatment test barley seedlings were found to display pronounced mottle symptoms a few days after they had emerged.

A survey was made in the winter of 1958, during which striped plants were only rarely observed. Isolated barley plants of the following varieties were infected: Beecher, Glacier, Nissanith, T.B. and Tunisith. Wheat of C.C.C. variety was once found infected.

In order to identify the causal virus, experiments were carried out to determine its properties.

Materials and methods

For inoculation experiments, test plants were grown in 10 centimeter pots in an insect-proof greenhouse and were fumigated with nicotine at regular intervals. Cultures of the virus were maintained in young actively growing barley plants of Atsel variety, which was shown by McKinney (5) to possess a high degree of susceptibility to barley stripe mosaic virus. Inoculum was prepared from sap extracted from young leaves of Atsel barley plants and diluted in about an equal amount of tap water. A small amount of carborundum (400 mesh) was generally added to the inoculum but in some of the tests it was lightly dusted on the plants to be inoculated. Test plants were inoculated by gently rubbing all their leaves with fingers wetted in the inoculum.

In all cases noninoculated plants were kept as controls under the same conditions as the inoculated ones. Sap from these control plants was extracted and rubbed on Atsel barley seedlings to establish if seed-borne virus was present in the test plants.

Systemic spread of the virus in the inoculated plants was always confirmed by back inoculations onto Atsel barley seedlings and, in a few cases, onto *Chenopodium amaranticolor*, which was found by Hollings (2) to show diagnostic local lesions to a number of plant viruses, including barley stripe mosaic virus.

Properties of the virus

Tests to establish the properties of the virus were made on Atsel barley seedlings at the 1 or 2-leaf stage. After each treatment the inoculum was tested on groups of 20 to 30 seedlings.

The virus was transmissible mechanically. The thermal inactivation point was found to be between 62° and 64° C. after a ten-minute exposure. The dilution end-point was found to lie between 10^{-3} and 10^{-4} in distilled water. No measurable reduction of infectivity in the expressed sap was recorded during the first three hours of storage, when tested at half-hourly intervals. The expressed juice lost infectivity after eight days' storage at room temperatures (maximum 31° C., minimum 11° C., daily mean 17° C.). Leaves of Atsel barley, which were kept in the desiccator over calcium chloride at room temperatures and tested at weekly intervals, were found to lose infectivity after storage of 139 days.

Host range

The barley and wheat varieties cultivated in Israel, so far tested, were all found susceptible, showing mottle stripes after inoculation. Atsel

[1] Publication of the Agricultural Research Station, Beit Dagon-Rehovot, 1959 Series, 300-E.

barley seedlings reacted in the manner described by McKinney (5). Oats of Mulga variety always yielded negative results but systemic spread of the virus was regularly observed in the plants of Saia variety. Single hybrid maize of Neve Yaar 22 variety was never susceptible. In sorghum of Yellow-Sooner variety, necrotic lesions were observed in inoculated leaves but the virus could not be recovered from new leaves formed after the inoculation. Smooth brome grass gave negative results and no reaction was observed on cucumber of Beit-Alfa variety. On *Chenopodium amaranticolor*, small chlorotic local lesions appeared about ten days after inoculation. Later these lesions reached a diameter of 2-3 millimeters and became pink. On plants of *C. murale*, chlorotic local lesions with a necrotic center appeared about three weeks after inoculation. Although symptoms were not evident on winter spinach, the virus could be recovered from this plant. Inoculation on Turkish tobacco of Samsoun variety always gave negative results.

Seed transmission

As already mentioned, test plants were always tested for the possible presence of seed-borne virus. Results were generally negative but in two barley varieties, Tunisith and B. M.C., the virus was found to be seed-transmitted. Symptoms on the seedlings of these varieties were not pronounced and the rate of seed transmission was not estimated.

On the other hand, when infected Atsel barley plants were grown in the greenhouse, about 30 percent of the seeds collected from such plants produced seedlings infected by the virus, confirming that the virus is seed-borne.

Discussion and conclusions

The general properties of the virus infecting barley in Israel correspond with those of barley stripe mosaic virus described by McKinney (4) and Hagborg (1). It has also been found to be seed-borne in Israel.

The reaction of some plants to inoculation with the virus in Israel agrees with that described for the barley stripe mosaic virus by different authors. Atsel barley and other barley and wheat varieties showed typical symptoms as described by McKinney (4). Oats were reported by McKinney (4) to be infected only with difficulty, and the varieties tested by Slykhuis (6) proved to be immune. Of the two oat varieties tested in Israel, Saia was easily infected, while Mulga was nonsusceptible. Smooth brome grass was considered immune by Slykhuis (6) and only a small percentage of plants was infected in tests carried out by McKinney (4). The writers also failed to infect this plant with Israeli isolates of the virus. The maize variety tested by the writers appeared to be immune and the variety Yellow-Sooner of sorghum showed local lesions. On the other hand, Slykhuis (6) mentioned several sorghum varieties as being immune to barley stripe mosaic virus. Cucumber was found to be immune just as reported by McKinney (4). On *Chenopodium amaranticolor*, infection of the virus produced local lesions, similar to those described in England (2, 3). Spinach was found to be susceptible in Israel but the symptoms described by Kassanis and Slykhuis (3) were not observed. On Turkish tobacco of Samsoun variety, local lesions such as described by McKinney (4) were not observed in Israel but such a reaction was also not found by Kassanis and Slykhuis (3).

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PLANT QUARANTINE ANNOUNCEMENTS

SWEDEN

Statutory Order No. 229 of 28 May 1959, published in *Svensk Författningssamling* No. 229 on 10 June 1959, concerns the importation of plants. It came into force on 1 July 1959, except certain provisions which will become effective 1 January 1960. The new Order revokes the following Statutory Orders: Order No. 36 of 29 September 1876, Order No. 3 of 11 January 1927, Order No. 50 of 6 March 1936, Order No. 8 of 12 January 1951, and Order No. 510 of 16 August 1955.

The present summary is based upon Order No. 229 as well as the *State Plant Protection Institute Circulars* No. 1/1959 and No. 3/1959 concerning the application of Order 229.

Importation prohibited

1. Plants infected or infested by any of the following diseases and pests (Appendix A of the Order):

- Fire blight (*Erwinia amylovora*)
- Bacterial canker (*Pseudomonas mors-prunorum*)
- Potato ring rots (*Corynebacterium sepedonicum, Pseudomonas solanacearum*)
- Potato wart disease (*Synchytrium endobioticum*)
- Red core of strawberry (*Phytophthora fragariae*)
- Dutch elm disease (*Ophiostoma ulmi*)
- Oak wilt (*Chalara quercina*)
- Ponderosa blister rust (*Cronartium harknessii*)
- Chestnut blight (*Endothia parasitica*)
- *Rhabdocline pseudotsugae*
- *Phaeocryptopus gäumannii*
- Woolly aphis (*Eriosoma lanigera*)
- San José scale (*Quadraspidiotus perniciosus*)
- Colorado beetle (*Leptinotarsa decemlineata*)
- Japanese beetle (*Popillia japonica*)
- Fall webworm (*Hyphantria cunea*)
- Oriental fruit moth (*Laspeyresia molesta*)
- Carnation tortrix (*Tortrix pronubana*)
- Mediterranean fruit fly (*Ceratitis capitata*)
- Potato root eelworm (*Heterodera rostochiensis*)

2. Plants that are infected or infested more than slightly by any of the following diseases and pests (Appendix A of the Order):

- All insect-transmittable viruses of potatoes
- Viruses of *Cydonia, Malus, Prunus* and *Pyrus*
- Viruses of *Ribes* and *Rubus*
- Viruses of strawberries
- Yellow disease of hyacinths (*Xanthomonas hyacinthi*)
- Scab of gladiolus (*Pseudomonas marginata*)
- Bacterial wilt of carnation (*Pseudomonas caryophylli, Erwinia* spp.)
- Crown gall (*Erwinia tumefaciens*)
- Bulb rots (*Sclerotinia bulborum, S. gladioli, S. perniciosum, S. tuliparum*)
- Fire of tulip (*Botrytis tulipae* and other species of *Botrytis*)
- Basal rot of narcissus (*Fusarium bulbigenum*)
- Leaf scorch of azaleas (*Septoria azaleae*)
- Hard rot of gladiolus (*Septoria gladioli*)
- Azalea gall (*Exobasidium japonicum*)
- Azalea leaf miner (*Gracilaria azaleella*)
- Potato moth (*Phthorimaea operculella*)
- Cherry maggot (*Rhagoletis cerasi*)
- Apple maggot (*Rhagoletis pomonella*)
- Narcissus flies (*Merodon equestris, Eumerus* spp.)
- Gall midge of chrysanthemum (*Diarthronomyia chrysanthemi*)
- Hazel big bud mite (*Eriophyes avellanae*)
- Current mite (*Eriophyes ribis*)
- Strawberry mite (*Tarsonemus fragariae*)
- Bulb mite (*Rhizoglyphus echinopus*)
- Mites of conifers (*Paratetranychus* spp.)
- Nematodes (species of *Aphelenchoides, Ditylenchus* and *Pratylenchus*)

The Plant Protection Institute may prohibit the entry of plants affected by pests and diseases other than those listed in Appendix A if they are deemed to be equally dangerous to Swedish crops.

3. Living pests enumerated above at any stage of development.

4. Cultures of the viruses, bacteria and fungi enumerated above.

5. Living plants of Ulmaceae, including bark and wood with bark adhered, but excluding seed.

6. Living barberry plants, including fruit and seeds belonging to *Berberis vulgaris* (all forms and varieties), *B. aethnensis*, *B. amurensis*, *B. cretica*, *B. nummularia*, *B. pachyacantha*, *B. soulieana*, *Mahoberberis neubertii* (= *Berberis neubertii*) and all grafted barberry plants.

7. Living plants of Douglas fir (*Pseudotsuga* spp.), excluding seed.

8. Earth and soil, nonsterile or nonsterilized (except when used for technical purpose), compost and animal manure. Imported plants should be as far as practicable free from soil but this requirement does not apply to conifer, azaleas, rhododendrons and other heather plants, water lilies and other aquatic plants, pot plants and other plants which must be shipped with soil.

9. Host plants of San José scale (excluding fruit and seed) from countries known to be infested by the scale. The following countries or parts of countries are considered to be free from this pest: Belgium, Denmark, Finland, Greece, Iceland, Ireland, Luxembourg, the Netherlands, Norway, the United Kingdom, Sweden, Federal Republic of Germany north of the rivers Main and Nahe, the parts of Switzerland and France that are outside of the San José scale protection zones Cyprus, Israel, Turkey and Tunisia. Ligneous plants of the following genera are regarded as hosts of San José scale.

Acer
Crataegus
Euonymus
Juglans
Malus communis
Populus
Ribes
Salix
Ulmus
Cotoneaster
Cydonia
Fagus
Ligustrum
Pirus
Prunus
Rosa
Sorbus
Syringa
Tilia

10. Living plants of pines (*Pinus* spp.) and oaks (*Quercus* spp.) from North America, excluding seed.

IMPORTATION PROHIBITED AT CERTAIN PERIOD

Plants cultivated in the open or in frames and intended for propagation or planting may not be imported from any country during the period 1 April-30 September, except that bulbs, corms, herbaceous nursery plants, strawberry plants, budwood, forest plants and potatoes may be imported at any other time, provided they have been treated in an approved manner against certain pests listed in Appendix A of the Order. Potatoes may not be treated with DDT or materials of equal or greater toxicity, such as mercury compounds.

IMPORTATION RESTRICTED

1. Living bulbs, corms and rhizomes, with or without developed leaves and flowers.

2. Living plants and roots not covered under 1, including cuttings and graft-wood.

3. Cut carnation flowers and flower buds, fresh, dried, bleached, dyed, impregnated or otherwise prepared.

4. Raw fruits and berries, excluding banana, pineapple, mango and other tropical fruit, wild forest berries, coconuts, and other nuts but including oranges and other citrus fruit. Asparagus, tomatoes, peppers, eggplants, pumpkins and cucumbers are subject to the same conditions as raw fruits and berries.

5. Raw or cooled vegetables, including potatoes, root crops, onions (except onion sets and small shallots that may be used for planting), and vegetables without roots.

General requirements

Consignments of plants listed above must be accompanied by phytosanitary certificates in prescribed form. The inspection referred to in the certificate must be carried out within 15 days prior to shipment. Importation should be made preferably through the ports of Gothenburg, Hälsingborg, Landskrona, Malmö, Stockholm or Trelleborg, where plant inspection service exists.

Special requirements

The importation of plants listed above, except fruits and berries and cut carnations, is further governed by the following requirements.

(*a*) Japanese beetle (*Popillia japonica*) must not occur during the preceding two years at the place of cultivation or within 20 kilometers thereof.

(*b*) Colorado beetle (*Leptinotarsa decemlineata*) must not occur at the place of cultivation or within 5 kilometers. The distance requirement does not apply to importations made during the period 1 October-31 March.

(*c*) In a country where the Colorado beetle or Japanese beetle occurs, the sorting and loading sites and the holds, wagons or containers must have been inspected by the Plant Protection Service of the exporting country immediately before loading or reshipment and found to be free from these pests.

(*d*) If potato root eelworm occurs in the country of origin, the place of cultivation must be found free from this pest, based on thorough soil examination by a standard method. Soil examination may be exempted if the control of this pest in the country of cultivation is regarded by the Swedish Plant Protection Institute as satisfactory. Rootless plants and cuttings rooted in sterile material, are not subject to this requirement.

(*e*) Potato wart disease must not occur at the place of cultivation or within 1 kilometer thereof, or, if a biotype other than the normal biotype of the pathogen, is involved, within 50 kilometers thereof.

(*f*) The plants must have been under supervision of the Plant Protection Service of the country of origin during the growing season and have not been found infected or infested with diseases or pests in such a manner as to preclude their importation under "Importation prohibited." Vegetables, including onions and ware potatoes are not subject to this requirement.

(*g*) Woody nursery plants are subject to an additional requirement that San José scale does not occur at the place of cultivation or within 5 kilometers thereof.

(*h*) Potatoes of all kinds are subject to an additional requirement that potato ring rots do not occur in the country of origin or at the place of cultivation; in the latter case, the Plant Protection Service of the country of origin should supervise the control of these diseases in accordance with the regulation in force in that country.

Exemptions

The following materials are exempt from general and special requirements mentioned above: Cereals and seeds; orchids cultivated on Osmunda fiber and bark; water plants for aquaria; cut branches, leaves and flowers for decoration (except cut carnations); sample consignments without commercial value of forest plants, vegetables without roots, and fresh fruits and berries; mycelia of edible fungi on sterile material; fresh fruits and berries, and vegetables, including onions, in lots not exceeding 5 kilograms brought in by travelers; single potted plants and single bouquets of cut carnations in traveler's luggage; flower bulbs and corms up to 5 kilograms and pot plants and other herbaceous plants from Denmark, Finland or Norway. Frontier trade with Norway and Finland is subject to special agreements with these countries.

PACKINGS AND PACKING MATERIAL

Prohibited packing materials

Hay, straw, halm, grass and moss, and used baskets, boxes, cartons, bags and used jute sacks.

Admissible packing materials

Sphagnum moss, common reed (*Phragmites communis*), peat, seaweed, sawdust, wood shavings, excelsior, cork, paper and sterile or sterilized sand.

In special cases, plants packed in prohibited materials may be permitted entry by the plant inspector, provided that the prohibited material is burned after unpacking.

Plants intended for importation should be packed in such a manner that the import inspection is not rendered unduly difficult or time-consuming.

Imported plants should be as far as possible free from soil (also see "Importation prohibited").

All packages containing plants mentioned under "Importation restricted" must be accompanied by itemized lists of contents and must be marked and numbered; the marks and numbers should be indicated in the phytosanitary certificate the invoice or other specification. For produce shipped in sealed wagons, holds or containers, designation of the means of conveyance is sufficient.

PHYTOSANITARY CERTIFICATE

A phytosanitary certificate must be issued by the Plant Protection Service of the country of origin in a form similar to that annexed to the International Plant Protection Convention 1951. It must be written in the language of the country of origin and, if necessary, with a translation in Swedish, Danish, Norwegian, English, French or German. The quantity of the plants must be given in kilograms and also in number of plants, where this is the normal practice in the trade. Additional declarations are not required if the consignments are in full agreement with the import regulations.

If the exporting country is not the country of origin, an attestation shall be added to the certificate to the effect that no measures have been taken in the exporting country that may invalidate the certificate.

The certificate should be accompanied by an invoice and both should be sent in triplicate to the forwarding agent at the port of entry prior to the arrival of the consignment.

TRANSIT TRAFFIC

Unless conveyed in sealed holds, wagons or containers, or in such a way as to prevent any risk to indigenous crops, plants whose importation is prohibited under these regulations may not be transported through Sweden or to a destination within the country.

Stabilimento Tipografico Fausto Failli — Roma

PLANT EXPLORATION, COLLECTION AND INTRODUCTION

FAO Agricultural Studies No. 41

The requirements of an ever-increasing world population have created a pressing need for the introduction of new plant material which might offer possibilities of crop and grassland improvement. In view of this need, some countries have already taken steps to deal with this problem, while others have voiced an interest in trying to resolve it on a national or international basis.

This study, in reviewing briefly the botanical history of some representative economic plants, presents various timely views on a co-ordinated scientific approach to the exploration, collection and introduction of new plant material, and presents suggestions as to how international organizations might help provide that co-ordination and technical guidance.

The study also indicates a need to consider how plant collections should be made and how extensive they should be in order to obtain a representative sample of the species or population being collected. Better scientific planning and conduct of exploration is advocated in place of the system of random collections of hundreds of thousands of samples.

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